Amendments to the Claims:

This listing of claims replaces all prior versions, and listing, of claims in the application:

Listing of Claims:

Claim 1 (currently amended): A method of forming a substrate optical waveguide having a propagation axis along which light is conveyed, a cladding layer, and a core element, the core element having an elongated dimension collinear with the waveguide's propagation axis and a transverse cross-section transverse to the elongated dimension, the method comprising the steps of:

(a) forming a lower cladding layer of **positive-type** photosensitive cladding material;

(b) exposing the cladding layer to actinic radiation through a first gray-scale mask;

(c) developing the exposed pattern to form a groove located in the lower cladding layer and having three-dimensional features**, the remaining portion of the lower cladding layer still being sensitive to actinic radiation**;

(d) thereafter treating the developed lower cladding layer to reduce its sensitivity to actinic radiation;

(e) [[(d)]] thereafter forming a core layer of photosensitive core material over the groove and ~~**the remaining portions of**~~ the **treated** lower cladding layer;

(f) [[(e)]] exposing the core layer to actinic radiation through a second gray-scale mask; and

(g) [[(f)]] developing the exposed pattern to form an element of core material located over the groove and having three-dimensional features.

Claim 2 (canceled)

Claim 3 (original): The method of Claim 1 wherein the photosensitive core material is positive type.

Claim 4 (original): The method of Claim 1 further comprising the step of forming an upper cladding layer over the exposed portions of the core element and lower cladding layer.

Claim 5 (currently amended): The method of Claim 1 ~~further comprising, after step (c) and prior to step (d), the step of~~ **wherein step (d) comprises** at least partially curing the lower cladding layer.

Claim 6 (canceled)

Claim 7 (original): The method of Claim 1 wherein the element of core material has a circular cross-section in a plane transverse to the waveguide's propagation axis.

Claim 8 (original): The method of Claim 1 wherein the element of core material has an oval-shaped cross-section in a plane transverse to the waveguide's propagation axis.

Claim 9 (original): The method of Claim 1 wherein the element of core material has top and bottom surface portions which are curved.

Claim 10 (original): The method of claim 1 wherein each of the cladding and core materials comprises a common base photosensitive polymer material, and wherein one of the cladding and core materials comprises a minor addition of a different polymer material.

Claim 11 (currently amended): A method of forming a substrate optical waveguide having a propagation axis along which light is conveyed, a cladding layer, and a core element, the core element having an elongated dimension collinear with the waveguide's propagation axis and a transverse cross-section transverse to the elongated dimension, the method comprising the steps of:

(a) forming a cladding layer of a **positive-type** photosensitive cladding material on a substrate, the solubility of the cladding material in a developer being a function of exposure dosage to actinic radiation;

(b) pattern exposing the cladding layer to actinic radiation through a first gray-scale mask, the first gray-scale mask comprising a first area for defining a first segment of the core

element, the first area having a length oriented to the propagation axis of the waveguide and a width for initially defining the transverse cross-section of the core element in the first segment, the first area of the first gray-scale mask having a gradation of opacity along its width;

(c) thereafter exposing the cladding layer to a developer to form a groove in the layer of photosensitive cladding material, **the remaining portion of the lower cladding layer still being sensitive to actinic radiation,** the groove having a first segment with a length disposed along the waveguide's propagation axis and a major curved surface which is curved in a direction transverse to the length of the grooves first segment;

(d) thereafter treating the developed lower cladding layer to reduce its sensitivity to actinic radiation;

(e) [[(d)]] **thereafter** forming a core layer of a photosensitive core material over the groove and the **treated** cladding layer, the solubility of the core material in a developer being a function of exposure dosage to actinic radiation;

(f) [[(e)]] pattern exposing the core layer to actinic radiation through a second gray-scale mask, the second gray-scale mask comprising a first area for further defining the first segment of the waveguide's core element, the first area having a length oriented to the propagation axis of the waveguide and a width for further defining the transverse cross-section of the core element in the first segment, the first area of the second gray-scale mask having a gradation of opacity in the direction of its width; and

(g) [[(f)]] thereafter exposing the core layer to a developer to form the first segment of the waveguide's core element.

Claim 12 (currently amended): The method of Claim 11, wherein the first gray-scale mask of step (b) further comprises a second area for defining a second segment of the core element, the second area having a length oriented to the propagation axis of the waveguide and a width for initially defining the transverse cross-section of the second segment of the core element, the second area of the first gray-scale mask having a first gradation of opacity along its width and a second gradation of opacity along its length;

wherein step (c) of exposing the cladding layer to a developer further forms the groove with a second segment with a length disposed along the waveguide's propagation axis and a major surface which is curved in a direction transverse to the length of the groove's second segment, the groove's second segment having a gradation in its width and a gradation in its depth;

wherein step **(e) [[(d)]]** of forming the core layer further forms the photosensitive core material over the second segment of the groove;

wherein the second gray-scale mask of step **(f) [[(e)]]** further comprises a second area for further defining the second segment of the waveguide's core element, the second area having a length oriented to the propagation axis of the waveguide and a width for further defining the transverse cross-section of the core element in the second segment, the second area of the second gray-scale mask having a first gradation of opacity in the direction of its width and a second gradation of opacity along its length; and

wherein step **(g) [[(f)]]** of exposing the core layer to a developer further forms the second segment of the waveguide's core element.

Claim 13 (currently amended): The method of Claim 11, wherein the first gray-scale mask of step (b) further comprises a second area for defining a second segment of the core element, the second area having a length oriented to the propagation axis of the waveguide and a width for initially defining the transverse cross-section of the second segment of the core element, the second area of the first gray-scale mask having a first portion with a first gradation of opacity along its width and a second portion with a radial gradation of opacity about a point;

wherein step (c) of exposing the cladding layer to a developer further forms the groove with a second segment with a length disposed along the waveguide's propagation axis and a major surface which is curved in a direction transverse to the length of the groove's second segment, the major surface of the groove's second segment further having a portion which is curved in the direction of the length of the groove's second segment;

wherein step **(e) [[(d)]]** of forming the core layer further forms the photosensitive core material over the second segment of the groove;

wherein the second gray-scale mask of step **(f)** **[[(e)]]** further comprises a second area for further defining the second segment of the waveguide's core element, the second area having a length oriented to the propagation axis of the waveguide and a width for further defining the transverse cross-section of the core element in the second segment, the second area of the second gray-scale mask further having a first portion with a gradation of opacity in the direction of the second area's width and a second portion having a circle or oval of constant opacity; and

wherein step **(g)** **[[(f)]]** of exposing the core layer to a developer further forms the second segment of the waveguide's core element. ~~**the groove's second segment**~~

Claim 14 (currently amended): The method of Claim 13 further comprising, between the performance of steps (c) and **(e)** **[[(d)]]**, the step of forming a layer of reflective metal on the bottom surface of the groove's second segment.

Claim 15 (canceled)

Claim 16 (original): The method of Claim 11 wherein the photosensitive core material is positive type.

Claim 17 (original): The method of Claim 11 further comprising the step of forming an upper cladding layer over the exposed portions of the core element and lower cladding layer.

Claim 18 (currently amended): The method of Claim 11 ~~**further comprising, after step (c) and prior to step (d), the step of**~~ **wherein step (d) comprises** at least partially curing the lower cladding layer.

Claim 19 (canceled)

Claim 20 (original): The method of Claim 11 wherein the element of core material has a circular cross-section in a plane transverse to the waveguide's propagation axis.

Claim 21 (currently amended): The method of Claim 11 wherein the element of core material has ~~**a circular**~~ **an oval-shaped** cross-section in a plane transverse to the waveguide's propagation axis.

Claim 22 (original): The method of Claim 11 wherein the element of core material has top and bottom surface portions which are curved.

Claim 23 (original): The method of Claim 11 wherein each of the cladding and core materials comprises a common base photosensitive polymer material, and wherein one of the cladding and core materials comprises a minor addition of a different polymer material.

Claims 24-30 (canceled).

Claim 31 (new): A method of forming a substrate optical waveguide having a propagation axis along which light is conveyed, a cladding layer, and a core element, the core element having an elongated dimension collinear with the waveguide's propagation axis and a transverse cross-section transverse to the elongated dimension, the method comprising the steps of:

(a) forming a cladding layer of a photosensitive cladding material on a substrate, the solubility of the cladding material in a developer being a function of exposure dosage to actinic radiation;

(b) pattern exposing the cladding layer to actinic radiation through a first gray-scale mask, the first gray-scale mask comprising a first area for defining a first segment of the core element and a second area for defining a second segment of the core element, the first area having a length oriented to the propagation axis of the waveguide and a width for initially defining the transverse cross-section of the core element in the first segment, the first area of the first gray-scale mask having a gradation of opacity along its width, the second area having a length oriented to the propagation axis of the waveguide and a width for initially defining the transverse cross-section of the second segment of the core element, the second area of the

first gray-scale mask having a first portion with a first gradation of opacity along its width and a second portion with a radial gradation of opacity about a point;

(c) thereafter exposing the cladding layer to a developer to form a groove in the layer of photosensitive cladding material, the groove having a first segment with a length disposed along the waveguide's propagation axis and a major curved surface which is curved in a direction transverse to the length of the grooves first segment, the groove further having a second segment with a length disposed along the waveguide's propagation axis and a major surface which is curved in a direction transverse to the length of the groove's second segment, the major surface of the groove's second segment further having a portion which is curved in the direction of the length of the groove's second segment;

(d) forming a core layer of a photosensitive core material over the first and second segments of the groove and over the cladding layer, the solubility of the core material in a developer being a function of exposure dosage to actinic radiation;

(e) pattern exposing the core layer to actinic radiation through a second gray-scale mask, the second gray-scale mask comprising a first area for further defining the first segment of the waveguide's core element and a second area for further defining the second segment of the waveguide's core element, the first area having a length oriented to the propagation axis of the waveguide and a width for further defining the transverse cross-section of the core element in the first segment, the first area of the second gray-scale mask having a gradation of opacity in the direction of its width, the second area having a length oriented to the propagation axis of the waveguide and a width for further defining the transverse cross-section of the core element in the second segment, the second area of the second gray-scale mask further having a first portion with a gradation of opacity in the direction of the second area's width and a second portion having a circle or oval of constant opacity;; and

(f) thereafter exposing the core layer to a developer to form the first and second segments of the waveguide's core element.

Claim 32 (new): The method of Claim 31 further comprising, between the performance of steps (c) and (d), the step of forming a layer of reflective metal on the bottom surface of the groove's second segment.

Claim 33 (new): The method of Claim 31 wherein the photosensitive cladding material is positive type.

Claim 34 (new): The method of Claim 31 wherein the photosensitive core material is positive type.

Claim 35 (new): The method of Claim 31 further comprising the step of forming an upper cladding layer over the exposed portions of the core element and lower cladding layer.

Claim 36 (new): The method of Claim 31 further comprising, after step (c) and prior to step (d), the step of at least partially curing the lower cladding layer.

Claim 37 (new): The method of Claim 31 further comprising, after step (c) and prior to step (d), the step of reducing the sensitivity of the lower cladding layer to the actinic radiation used in step (e).

Claim 38 (new): The method of Claim 31 wherein the element of core material has a circular cross-section in a plane transverse to the waveguide's propagation axis.

Claim 39 (new): The method of Claim 31 wherein the element of core material has an oval-shaped cross-section in a plane transverse to the waveguide's propagation axis.

Claim 40 (new): The method of Claim 31 wherein the element of core material has top and bottom surface portions which are curved.

Claim 41 (new): The method of Claim 31 wherein each of the cladding and core materials comprises a common base photosensitive polymer material, and wherein one of the cladding and core materials comprises a minor addition of a different polymer material.